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E-maintenance as an Emerging Customer Value Generating IT-enabled Resource

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E-MAINTENANCE AS AN EMERGING CUSTOMER VALUE GENERATING IT-ENABLED RESOURCE

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Abstract

This paper reports business related challenges and opportunities for e-maintenance as an emerging customer value generating IT-enabled resource. The research study is concerned with the e-maintenance based on remote diagnostics in the vehicle industry. E-maintenance of vehicles is of great importance as e-maintenance technology has great potential to provide various state of the art maintenance related services for the vehicles. This emerging technology brings challenges and opportunities to generate value both for the companies and their customers. In this paper, we have presented several business related challenges and opportunities for e-maintenance. In the form of a set of propositions, the contribution of this paper is to conceptualize e-maintenance as an emerging customer value generating IT-enabled resource by showing challenges and opportunities related to it.

Keywords: E-maintenance, IT-enabled resource, Challenges, Opportunities, Customer value

1 INTRODUCTION

Rapid developments in information and communication technologies bring challenges and opportunities to the existing cultures of maintenance in different industries (Angeles, 2005). Information technology based maintenance is referred as e-maintenance (Li et al., 2005). E-maintenance emerges with globalization and fast growth of the information and communication technologies (Han and Young, 2006). E-maintenance has been into considerations and gaining more attention in contemporary maintenance related literature.

E-maintenance is a broad concept covering a variety of maintenance related services including vehicle diagnostics, quality assurance, and others (Jonsson et al., 2010). Remote diagnostics systems also come under the class of e-maintenance systems (Jonsson et al., 2010, Campos, 2009). These systems can automatically monitor performance, diagnose problems and request attention from service technicians if any problems are detected (Biehl et al., 2004). This paper concerns the concept of e-maintenance as remote diagnostics systems.

The existing literature showing challenges and opportunities in e-maintenance are mostly focusing on the technological challenges and opportunities (Kuschel, 2009). Some scholars (Kuschel, 2009; Jonsson, 2010) have written about the business related issues in e-maintenance and those literature focus on the outcome of deploying e-maintenance in the firm. The competitive environment in manufacturing firms compels most of them to think in advance about the challenges and opportunities regarding their future products and services (Lyytinen and Yoo, 2002). But the pre-implementation business related challenges and opportunities of e-maintenance have not been investigated widely.

This paper focuses on business related challenges and opportunities of e-maintenance of the vehicle based on remote diagnostics systems. The systems will automatically monitor and diagnose problems that occur in the vehicle while it is running on the road. We argue that this e-maintenance based remote diagnostics systems can be an emerging IT-enabled resource for the vehicle manufacturing company to generate customer value. Customer value is defined by Woodruff (1997, p. 142) as, "a customer's perceived preference for and evaluation of those product attributes, attribute performances and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations". We argue that e-maintenance based on remote diagnostics systems face the challenges of becoming a customer value generating IT-enabled resource because the technology has the potential to serve the customers of vehicle manufacturers to provide the services of fault monitoring and diagnostics of vehicles and thus better operation of the vehicles.

Recent research has shown an increased interest in this area. For example, Yoo et al. (2010a) described some of the challenges and opportunities associated with digital innovation in general. Lyytinen and Yoo (2002) provide some issues and challenges in ubiquitous computing. Kuschel (2009) provides business, technical and organizational pre-requisites for vehicle services. But, there is still a gap to synthesized challenges and opportunities specifically associated with e-maintenance in the vehicle industry. The business challenges and opportunities of e-maintenance are required to be investigated to build a foundation for e-maintenance as an emerging customer value generating IT-enabled resource. The purpose of this paper is to present those challenges and opportunities and investigate the e-maintenance as an emerging customer value generating IT-enabled resources.

So, we pose the research question as, "what are the business related challenges and opportunities for e-maintenance as an emerging customer value generating IT-enabled resource"?

The paper is structured as follows: First, we ground our rationale by providing related studies on e-maintenance, IT-enabled resource and customer value. This is followed by research approach which contextualizes the empirical work. Thereafter, we provide the results and findings from the empirical material. In the discussion section, a set of propositions are presented based on the findings.

2 RELATED LITERATURE

2.1 E-maintenance

The existing studies show some business related challenges and opportunities of e-maintenance in various industries. Among the business related challenges of e-maintenance, human resource restructuring, maintenance agreement and training have been pointed out (Ong et al. 2004). There is lack of reference points to understand the possible benefits of e-maintenance (Jantunen et al. 2010). Supporting right strategic decision making can be challenging in e-maintenance (Ucar and Qui, 2005). In case of e-maintenance, designing new business models can be a challenge (Muller et al., 2008). Industrial adoption and integration of relevant standard is another challenge (Muller et al., 2008). As far as business related opportunities of e-maintenance are concerned, e-maintenance can increase the level of transparency in business processes (Hausladen and Bechheim, 2004) and can optimise return on investment (ROI) (Moore et al., 2006). Cost reduction is another great opportunity through e-maintenance (Jantunen et al., 2010). There is a possibility of customer up-time which means any possible faults of the machines will be predicted and the machines can be repaired before any serious breakdown occurs (Jonsson et al., 2010). Through e-maintenance there is a possibility of better information flow in organizational boundaries (Jonsson et al., 2010). Finally, Kuschel (2009) have explored the technical, business and organizational pre-requisites for the development and diffusion of rich variety of such services.

Although the existing studies discuss some challenges and opportunities of e-maintenance, most of them are basically comparison of different e-maintenance technologies in different industries. They did not investigate challenges and opportunities of e-maintenance through conducting empirical activities with representatives from any particular industry. So, those studies lack the view of the people working in the industry. Moreover, none of the previous research explicitly mentions e-maintenance as a potential IT-enabled resource.

2.2 IT-enabled resource and customer value

Bharadwaj (2000) describes customer orientation as an intangible resource that information technology enables. Customer orientation strategies such as customer relationship management are rooted in the core IT capability of the firm (Bharadwaj, 2000). A key capability for superior customer orientation is the ability to track and predict changing customer preferences and enabling IT will help the firm to track customer choices more rapidly.

Resource level synergies may allow an organization to use an IT-enabled resource to capitalize on strategic opportunity such as building strong customer relationship (Nevo and Wade, 2010). Moreover, information technology can develop products that are of higher quality, that can be delivered faster, or that are cheaper. With the help of information technology, existing products can be tailored and new products or services can be developed according to customers' needs (McFarlan, 1984). For early stage innovative technology, Chesbrough and Rosenbloom (2002) argue that business model plays a vital role in capturing customer value. Yoo et al. (2010b) state that re-programmability of digital innovation allows the users to create, manipulate different contents in their digital artifact thus providing a bridge between the users and manufacturer. It has the possibility to enhance customer relationship.

It can be argued that with the introduction of e-maintenance in the vehicles, first of all, there is a possibility for the vehicle manufacturing organization to build better relationship with the customers as the on-board remote diagnostics will inform about the condition of the vehicles that customers own. Based on that information, the vehicle manufacturer will get in touch with the customers if there is something wrong in the vehicle. In this way, the possibility of better customer relationship can be established. Secondly, there is possibility for remote diagnostics to help the manufacturers to develop services that are required for the customers' vehicle. So, the theories of IT-enabled intangibles and IT-

enabled resource help us to understand the capability of IT-enabled resource to generate customer value. We argue that e-maintenance is such an IT-enabled resource.

3 RESEARCH METHOD

This paper reports from a collaborative research project with an organization in the vehicle industry. The project aims at implementing on state of the art remote monitoring and diagnostics technology that is embedded in the vehicles. The technology opens the door for providing various vehicular maintenance services including remote monitoring and diagnostics of engine faults, air filter status etc. Many services can be developed based on this technology and an exploration of the services is required together with the representatives (such as business managers, maintenance manager, service developers, and prospective customers) from the industry. The intention is to bring change in current maintenance services and the collaboration between the academics and practitioners is organized as such that it can be characterized as action research (Baskerville and Myers, 2004; Kock and Lau, 2001; Mathiassen, 2002).

In line with action research (Baskerville and Myers, 2004), the project is organized as a collaborative process during the different project stages. At this point of time, diagnosis phase of action research is completed within exploration phase of project to understand and explore the business related challenges and opportunities associated with the emerging technology. We conducted number of activities in order to generate data together with different participants from the vehicle industry. The activities include interviews, workshops, project meetings and observations and e-mail correspondences. Following paragraphs show the details about the activities.

The study began with extensive number of service development meetings (1-2 hours) with the purpose to narrow down the scope of project. Meeting notes and summary documents provided the participants' expectations are coupled with other documents. The participants involved in the meetings include business area representatives, service developers, maintenance managers, project managers, and informatics and technical researchers. Total 26 meetings were held and moreover eight monthly project meetings (each of which was 3 hours in length) were also held. These were generic in nature and discussed project issues and opportunities which occurred across the disciplines such as technical, service development and business. Cross-disciplinary inputs about opportunities and challenges were collected from business area representatives, maintenance managers, technical and service developers.

The initial development meetings were followed by conducting four semi-structured group interviews with the purpose to get rich information. The interview study was designed by following the work of Myers and Newman (2007) and Schultze and Avital, 2010). Even though, the interviews are rich sources of interpretations, they were supplemented with other sources.

A rich picture about opportunities and challenges was obtained from three workshops (conducted as half-day activities). The discussion during the activity were recorded and later transcribed to interpret data. These were one of the major sources of information while networks were drawn with the particular business area representatives to find out existing status and potentials of remote e-maintenance.

Using Ryan and Bernard's (2003) techniques to identify themes, we have conducted a thematic analysis of the collected data. Hence, each of these requires a different kind of interpretation to give sense to data with the overall aim of finding the challenges and opportunities. Out of the available materials, the interviews and workshops served as the main sources of analysis. The interviews were transcribed and interpreted to find themes and sub-themes while other documents were interpreted and analysed to add information to the results. A follow-up study of the results through e-mail was made possible with relevant participants in order to avoid researchers' biases and assuring the findings. These results were also supplemented by the analysis of documents such as weekly project reports, meeting notes, and company documents.

On the basis of the data collection and analysis, we proceeded to results and findings about the challenges and opportunities based on remote diagnostics systems. The interpretations are guided by Walsham (2006). Next section provides the results obtained from the analysis of the data.

4 RESULTS

On the basis of the data analysis, several business challenges and opportunities have been identified for e-maintenance as an emerging customer value generating IT-enabled resource.

Challenges

From analysis of data we have found number of business related challenges and opportunities. These have been presented in the following paragraphs.

Data analysis shows that the reason for designing new business model is due to the current focus on tangible product oriented business. Traditional way of vehicle manufacturing business focuses on selling the vehicles and the business model is designed according to that. There is a great deal of dependency towards that type of business model. Any type of intangible service provision requires new business model. One manager explained:

Today the company is very much tangible product oriented but now we want to focus on providing services to the customers. We still don't have a business model for providing knowledge based services such as remote diagnostics services. The current business model is basically for the tangible products.

Service orientation is itself pointed out to be a challenge for the company that focuses more on selling tangible products such as, vehicles. So, the business model design is closely connected to the understanding the difference between tangible product and services. A comment from one of the company representatives was:

There are many challenges in service orientation. Most important is to understand that we are not only selling machines but also selling value to the customer. So, we need to rethink our business model. The delivery of services is also a challenge. It requires lot of investment.

Another comment from a company representative echoed the similar point:

We are now doing very product oriented business and we would like to sell services to show that a customer gets more from us in comparison with other vehicle manufacturer.

The vehicle maintenance is provided by the company through service contracts, i.e., the customers can sign a contract with the vehicle manufacturer if they want maintenance services from the company. But the issue regarding how to persuade customers to have remote diagnostics in their vehicles is a challenge. Apparently, it seems like it should be included with service contracts. As a business area representative mentioned:

I don't think remote diagnostics can be sold to the customers as a stand-alone service. This new service can be included in a service package.

Data analysis shows that identifying customer needs related to vehicle maintenance is difficult. Although remote diagnostics system promises a radical change in vehicle maintenance, putting it with the customer requirement context seems to be a challenge. As remote diagnostics systems come with various services, it is necessary to know what customers need regarding their vehicle maintenance and that will be a challenge. It is evident from one business participant's comment:

We are now working with customer relationship management where we are trying to map out what they really need and trying to generalize. And we find it extremely difficult to do that.

Many commercial vehicle owners have their own maintenance facilities or do maintenance by other companies. So, they do not normally buy the services offered by the vehicle manufacturing

companies. Remote diagnostics systems need to have some features that can attract customers. Then they might be interested to buy services. One comment from participants was:

Persuading customers to sign service contracts is difficult. They compare the prices of different maintenance services provided by different companies. If our service package offers something that the customers would like to have and other service providers do not offer, that will be a plus point.

Another challenge for e-maintenance is associated with the standardization of services. Systems put in different vehicles should function in a similar fashion. Differences in performance from vehicle to vehicle might affect customer satisfaction level. The current maintenance is facing the problem of standardization and that is applicable for remote diagnostics too. It is evident from one business representative's comment:

We are trying to standardize maintenance services through training the mechanics. Standardizing of maintenance services is possible to some extent especially with some processes but 100% standardization will be difficult. At the end of the day, customer satisfaction level will judge how much standardized our services are.

Opportunities

The analysis of data shows not only business related challenges but also several opportunities which are described below.

Through remote diagnostics there is very good possibility to reduce the operating cost of the vehicle as the vehicle will be able avoid break down if the faults are detected early. This will increase the uptime of the vehicle. The following comments of a business representative shows this opportunity of remote diagnostics

If our maintenance services lower the operating cost of the customer and increases uptime of the vehicle, that would add value to the customer.

Services added with the products can increase the possibility to become more customer-centric. Remote diagnostic opens the door for the vehicle manufacturer to involve with the customers as that technology will monitor the customers' vehicle whether it is working fine or not and the company can inform the customer before anything goes wrong. This will definitely increase the interaction between the company and the customers. And that is what the company representative is aiming for:

We are trying to add services with the vehicles. Traditionally we sold vehicles and that was it. Now we are trying to be more customer-centric through adding services. Because we know that we will not be able to survive in the future by selling only the vehicles. So, we need to do something regarding the services.

Remote diagnostics systems can add a 'feel good' factor at the customer side. It is evident from one of the business area representative comments:

Through maintenance services we would like to send a message to the customers that we would like them to feel privileged.

One business area representative's comment

The more information we have about customers' vehicle condition, the more we can be involved with the customers.

Another opportunity of remote diagnostics is to guarantee customers' vehicular operation. Many customers use the vehicles for business purposes and breakdown of vehicle means big loss in their businesses. If remote diagnostics can ensure zero breakdown through early prediction of faults it will be great:

There is a group of customers who will be interested to pay for remote diagnostics for increased uptime. Those who see the vehicles as assets and their business might be damaged if unexpected

malfunctioning occurs in the vehicles. And if the customers understand that the operating cost will be lower with the remote diagnostics and the vehicle utilization will be increased, then there is a market for remote diagnostics.

Identifying faults early in the critical parts of the vehicle and informing that to the customers will really add to the customer value. As a business representative narrates:

We can add remote diagnostics in the service contracts and inform the customers that it looks into the critical parts of the vehicle and the customers will be made aware in advance and accidents will be prevented.

Looking at the environmental issues can be another opportunity for remote diagnostics as many customers are willing to pay for healthy environment:

Some customers are very environment conscious. If the things that pollute the environment can be checked or diagnosed through remote diagnostics then those customers will be interested.

From the discussion with the technology developer we have known that Remote diagnostics systems will provide a unique opportunity for the customers to add more services at any stage of the vehicle lifetime. The service development will be a continuous process by the technology developers and they can inform the customers about their new development and the customers can add those newly developed services in their vehicles which are already enabled by remote diagnostics. One service developer explained it during a project meeting:

RDS (Remote diagnostics system) can be compared with the invention of electricity which was initially used for lighting bulbs. But later on it was used for numerous purposes and everyday different types of use of electricity are being developed. RDS is not just about monitoring the status of the engine. Several services can be developed based on the remote diagnostics technology and many services can be included later on with the existing services. Right now identifying all possible services is difficult. For example, I can see that driver behavior can also be examined through this technology to check how smoothly or roughly the driver drives the bus.

5 DISCUSSION

In this section we will present a set of propositions based on our findings. Empirical findings suggest that business model is one of the biggest business related challenges for e-maintenance as an emerging IT-enabled resource. It is evident that for successful business outcome, the regular tangible product oriented business model will not work. Traditional business model will not be helpful to gain customer value as services require more customer-centric approach. Designing new business model for services such as e-maintenance services is essential. Shifting from the tangible product oriented thinking towards service oriented thinking is a big obstacle for business success of remote diagnostics. Remote diagnostics itself is a service and product oriented thinking will not ensure the success of remote diagnostics. Chesbrough and Rosenbloom (2002) state that business model starts by creating value for the customer, and constructs the model around delivering the value. Thus we arrive at the following proposition:

Proposition 1. *E-maintenance services require new business model for generating customer value as existing business models of the tangible product oriented businesses have less focus on services.*

To gain maximum customer value it is obvious to understand their needs. There might be some specific issues regarding vehicle maintenance that must be known from the customers so that remote diagnostics can deal with those issues. Matthing et al. (2004) point out that customers' service ideas are found to be more innovative in terms of originality and user value, than those of professional service developers. Thus we can formulate the next proposition as:

Proposition 2. *E-maintenance services require co-creation of services together with the customers to generate customer value.*

Empirical observation suggests that standardization of remote diagnostics services need to be ensured so that the systems work same way in different vehicles. Showing different characteristics in different vehicles own by the same customer will not help the technology to gain maximum customer satisfaction and can hamper the service contract business. So, we can formulate the next proposition:

Proposition 3. *Without standardization, e-maintenance services will not be able to generate customer value.*

From empirical material it is evident that remote diagnostics is not just an engine monitoring and diagnostics tool. Different services can be designed based on the needs for the vehicles of the customers and those can be added anytime with the existing remote diagnostics services. In this way, it will become more customer-centric. Customers will have the opportunity to add new services with the existing services. It is the biggest opportunity for the e-maintenance technology to establish itself as an emerging IT-enabled resource for generating customer value. Moreover, Yoo et al (2010b) discuss about the re-programmability of the digital innovation characteristics where the customers of the digital artifact will have the opportunity to add different services at any time. So, we can construct the following proposition:

Proposition 4. *E-maintenance provides the opportunity to be reprogrammable, i.e, anytime different kinds of services can be added with the existing services.*

Empirical observations show that with the help of remote diagnostics, relationship between the customers and the vehicle manufacturer will improve to a great extent. If the uptime of customers' vehicles can be increased through remote diagnostics, customer satisfaction level will be increased. They will be interested to invest more for the services that are obtained from remote diagnostics. Remote diagnostics has an opportunity to make the vehicle safe and in this way it can save the break-down of the vehicle which is a common incident for any vehicle. Especially in case of commercial vehicle, breakdown can hamper the business activity. Jonsson et al. (2010) also point out that e-maintenance can increase customer uptime. Moreover, remote diagnostics has the opportunity to reduce the cost of operating the vehicle. As long as any vehicle runs on the road without any break-down, it saves a lot of money for the vehicle operator. Moreover, traditional maintenance costs money because in that case the vehicles have to be checked even if they do not have any problem. Remote diagnostics can save money if it will make sure that the maintenance is done only when it is needed. Our findings echo with the view by Jantunen et al. (2010) who state that cost reduction is another great opportunity through e-maintenance. Thus we can arrive to the following proposition:

Proposition 5. *E-maintenance will be able to raise customers' satisfaction level by increasing uptime of the machine and reducing the overall cost of the maintenance activities.*

6 CONCLUDING REMARKS

The research reported in this paper is a contribution to the increased understanding of the environment associated with service oriented economy in the digital age. We concur with Lyytinen and Yoo (2002), that digital technologies are providing more challenges and opportunities and that one of the new centers of interest in the IS research. This will relate to the role of digital technology in the future economy and human enterprises.

This paper is a contribution to the understanding of the business aspects of e-maintenance based on remote diagnostics in the vehicle industry. Theoretically, it adds to the knowledge of conceptualizing e-maintenance as an emerging customer value generating IT-enabled resource.

The context of this study provides the possible limitations in the research context, i.e., it studies the challenges and opportunities with IT-enabled resources and not with any IT-related challenges and opportunities. Even so, our aim is that the results will be of value to understand the challenges and opportunities in such an environment.

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